POWER PLANT CONTROLLER

USER MANUAL

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Rev. 00

English

- This manual is integrant and essential to the product. Carefully read the instructions contained herein as they provide important hints for use and maintenance safety.
- This product is to be used only for the purposes it has been designed to. Other uses should be considered improper and dangerous. The manufacturer is not responsible for possible damages caused by improper, erroneous and irrational uses.
- Elettronica Santerno is responsible for the product in its original setting.
- Any changes to the structure or operating cycle of the product must be performed or authorized by Elettronica Santerno.
- Elettronica Santerno assumes no responsibility for the consequences resulting by the use of non-original spare-parts.
- Elettronica Santerno reserves the right to make any technical changes to this manual and to the product without prior notice. If printing errors or similar are detected, the corrections will be included in the new releases of the manual.
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1. GENERAL INFORMATION ON THE PRODUCT

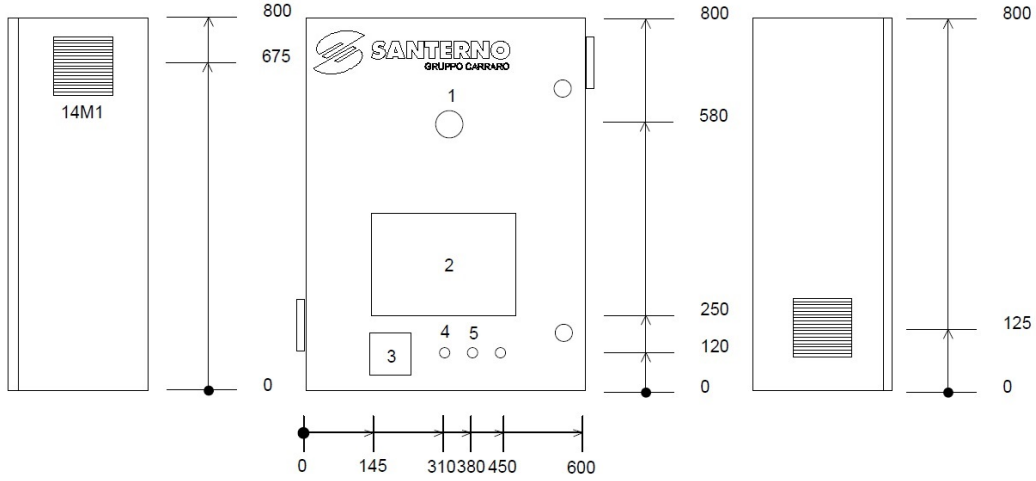
WARNING

For a correct and risk-free use of the equipment, make sure that all the parameters provided by the manufacturer are respected and that all the check procedures and test procedures are carried out according to the instructions provided.

1.1. Cabinet Identification and Ratings

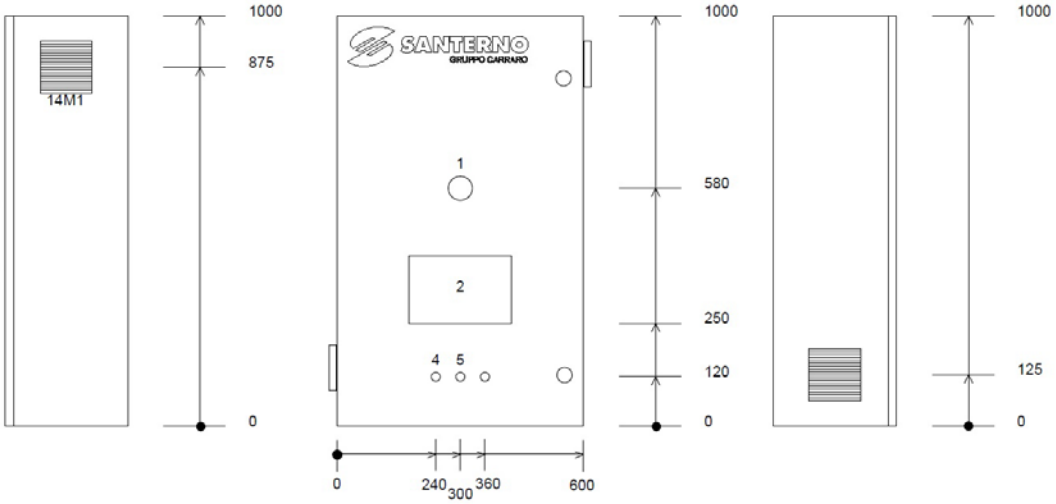
SANTERNO PPC 15 cabinet. May control up to 15 inverters.

1= 10Q1
2= 25A1
3= 13A1
4= 25H1
5= 39H1



SANTERNO PPC 180 cabinet. May control up to 192 inverters.

1= 10Q1
2= 25A1
4= 25H1
5= 41H1



The cabinet is provided with a hinged door allowing 120° opening.

1.2. Main Functions Standardly Included

- Auxiliary services power supply and low voltage distribution
- Interface point for the connection to the external network for the remote monitoring services
- Equipment control via PLC
- HMI, touch panel

1.3. Nameplate

The cabinet nameplate provides all the technical and identification data.

- Part Number assigned to the equipment by Elettronica Santerno.
- CE mark and list of the Regulations applicable to the construction of the equipment (CE is a collective registered mark).
- Serial Number of the equipment
- Cabinet specs

The nameplate is silver-coloured and measures 100x70mm.

Example of a nameplate:

1.4. For Whom This Manual is Intended

This manual is intended for:

- Installers
- Operators
- Person in Charge for the management of a PV plant

See section Definitions.

1.5. Attached Documentation

The following documents are always provided with the Power Plant Controller:

Document name	Scope
Installation Guide	This guide. Any information related to the transport, assembly, installation and maintenance of the product is described herein.
Electrical and Mechanical Schematic	This document contains detailed information related to the internal layout and the electrical schematic of the cabinet.
Test Certificate	This document contains information on the execution and the results of the Production Test.
Conformity Declaration	Conformity Declaration to the applicable Regulations.

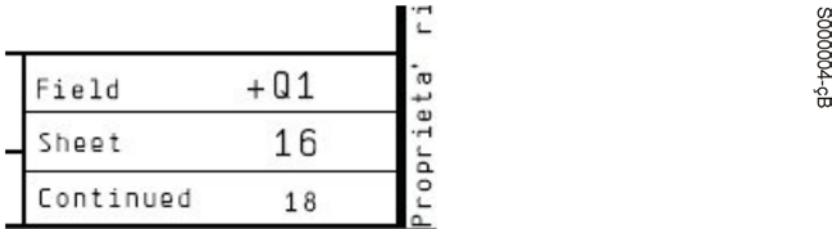
1.6. Preservation of the Documentation

All the documents related to the Power Plant Controller cabinet shall be preserved for the entire service life of the product, along with the PV installation documentation, and shall always be easily accessible.

1.7. Electrical and Mechanical Schematic

The editing technique is described hereafter. This description will allow the reader to fully understand the electrical and mechanical schematic and to easily identify the equipment components.

The pages of the electrical schematic are distinguished by three different numbers in the bottom right-hand corner:



"**Field**" indicates the location of the components:

+Q1 = Inside the electrical cabinet

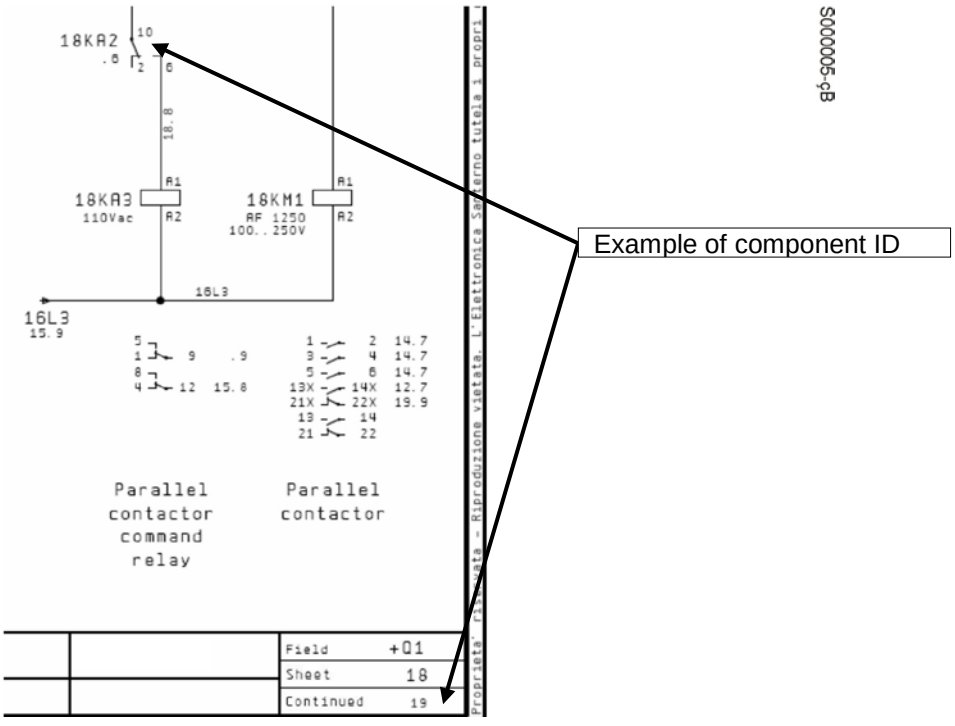
+Q1F = On the front of the electrical cabinet

+EXT = External device

"**Sheet**" indicates the progressive number of each sheet in the electrical schematic.

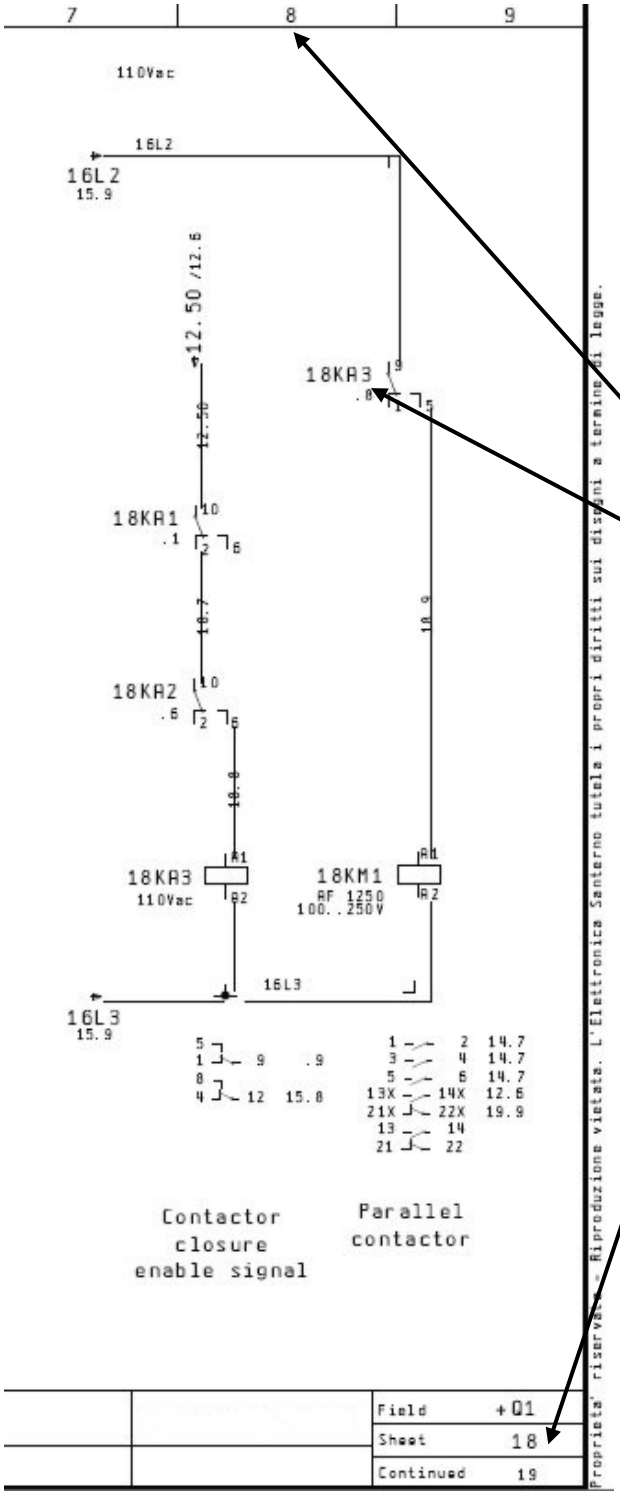
"**Continued**" indicates the number of the following sheet.

The ID code for each component and conductor relates to the first page in which the component or conductor appears, usually based on the direction of energy flow, followed by a progressive number.



Cross-references are provided in the electrical schematic for conductors and components which appear on more than one page. The cross-reference format is: Sheet. Column.

The sheet number is not indicated in the cross-reference if the reference of the component appears in the same sheet. Only the column number is therefore indicated.



Example: if the sheet number is not included in the cross-reference, this means that a secondary element of the component is shown on the same sheet.

Since the cabinet is to be integrated into a system composed of multiple elements, each one accomplishing a specific function, the numbering scheme of some of the components or conductors connected to the cabinet may differ from the one above, since such components/conductors may be related to another part of the system.

1.8. Test Certificate

The Test Certificate is prepared by the technicians of Elettronica Santerno while testing the Power Plant Controller cabinet. It contains all the information related to the execution and the results of the Production Tests.

1.9. Symbols Used in this Manual

KEY:

DANGER

Indicates an operating procedure which, if not carried out correctly, may lead to injuries or even death caused by electric shock.

CAUTION

Indicates an operating procedure which, if not carried out correctly, may cause serious damage to the equipment.

NOTE

Indicates important information concerning use of the equipment.

1.10. Definitions

Installer

Technician responsible for setting up, positioning and installing the equipment in compliance with the system diagram and in accordance with first-class, professional criteria.

Operator

Worker who has been suitably trained and informed on the risks and relative safety procedures to be adopted. The operator can carry out routine maintenance on the equipment.

Plant manager

Person who co-ordinates or manages system management activities and is responsible for ensuring health and safety standards are adhered to.

Technical room

Place used for housing the technological systems such as the wiring, plumbing, heating, air-conditioning, lifting and telecommunications systems.

It is equipped with suitable forced-air ventilation and/or air conditioning and is also fitted with appropriate safety devices governing access, maintenance and fire-prevention.

Person in charge of running the electrical system (System Manager)

Person with the highest level of responsibility concerning operation of the electrical system. If required, some of his/her tasks may be delegated to others.

Person in charge of working activities (Works Supervisor)

Person with the highest level of responsibility concerning the execution of work. If required, some of his/her tasks may be delegated to others.

The Works Supervisor must give all persons involved in the execution of work activities the relative instructions concerning reasonably foreseeable dangers which may not be immediately apparent.

Skilled electrician

Someone who has been trained and has enough technical knowledge or experience to enable him/her to avoid the dangers which may be generated by electricity.

Instructed person

Someone who has been adequately advised or supervised by a skilled person to enable him/her to avoid the dangers which may be generated by electricity.

2. CAUTION STATEMENTS

This section covers safety statements. The non-observance of the safety instructions below may cause serious injury or death and equipment failure. Carefully read the instructions below before installing, starting and operating the equipment.

Only competent personnel must carry out the equipment installation.

SAFETY RECOMMENDATIONS TO FOLLOW DURING USE AND INSTALLATION OF THE EQUIPMENT:

NOTE

Always read this instruction manual thoroughly before starting the equipment.

DANGER

ALWAYS EARTH THE EQUIPMENT.

CAUTION

The Power Plant Controller cabinet is to be used only as described in this manual. Any use other than that described in this manual is to be considered inappropriate and therefore improper.

DANGER

ELECTRIC SHOCK HAZARD

Avoid touching electrical parts when the equipment is powered on.

Never work on the equipment when powered on.

EXPLOSION AND FIRE RISKS

The risk of explosion or fire may exist if the equipment is installed in a room containing flammable vapours. Do not install the equipment where there is a risk of explosion or fire.

CAUTION

Do not connect supply voltages which exceed the rated voltage. If voltage exceeding the rated value is applied, the internal circuits may be damaged.

Do not carry out isolation tests between the power terminals or between the control terminals.

Make sure that the screws on the connection terminal board have been tightened correctly.

Observe the ambient conditions for installation.

The electronic boards contain components which are sensitive to electrostatic charges. Do not touch the boards unless absolutely necessary. Should this be the case, take all the necessary precautions to prevent damages caused by electrostatic charges.

2.1. Intended Use

The Power Plant Controller cabinet must only be used as described in this manual.

Any use other than that described in this manual is to be considered improper and therefore non-compliant.

2.2. Qualified Technical Personnel

All work on the cabinets must be carried out by skilled technical personnel only. By skilled personnel it is intended persons who have been suitably trained to carry out the work in question.

To commission and use the self-power supply cabinet, personnel must know and understand the instructions for installation and use. In particular, all safety warnings must be strictly observed.

2.3. Execution of Work

Maintenance, configuration modifications and management operations require the involvement of all production and maintenance personnel. These activities **must be carried out in observance of health and safety regulations**.

The Standards and Laws governing this aspect vary depending on the personnel involved, methods of access and/or the tasks which may be carried out on the product and envisage constructive measures aimed at guaranteeing adequate levels of safety.

Standard EN 50110-1, second edition, identifies the people who are granted access to the product:

- Person in charge of running the electrical system (System Manager).
- Person in charge of work activities (Works Supervisor).
- Skilled electrician.
- Instructed person.

Please refer to section Definitions.

Standard EN 50110-1 governs the way work in a plant is carried out and the relationship between the aforementioned persons who may work on the plant to maintain the electrical safety conditions stipulated by European Directives.

2.4. Accessing the Equipment: Safety Procedure

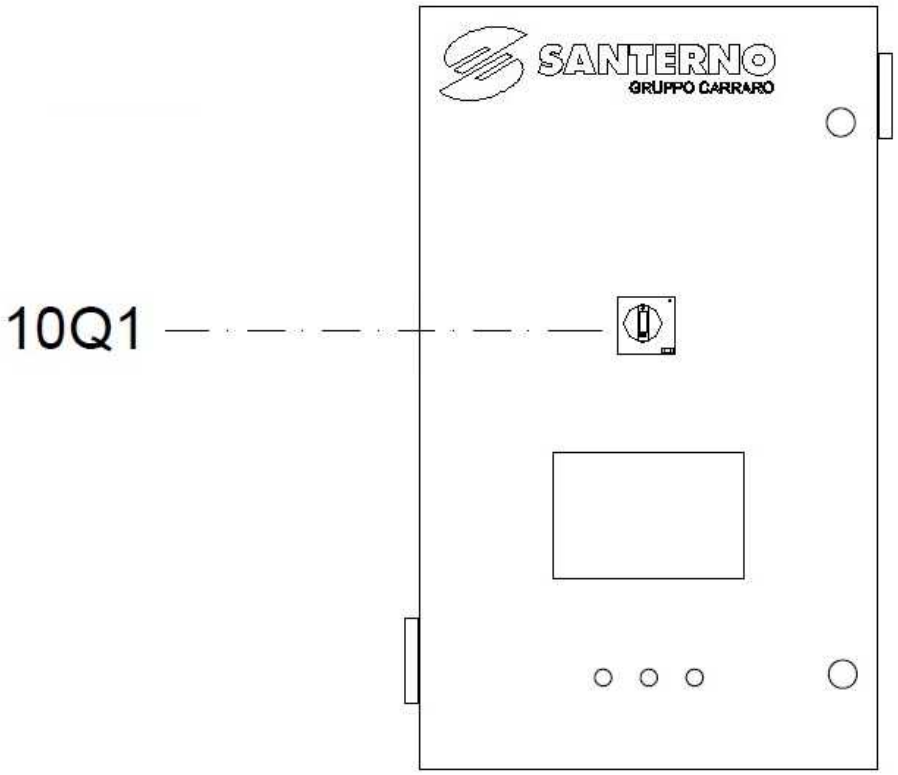
DANGER

Circuits may be live even when the master switch is in open position.

Always put the equipment in safety conditions before carrying out any operation inside the automatic power supply cabinet. To do this, follow the instructions below:

- Cut off direct line master switch 10Q1. The upstream circuit is energized even after master switch 10Q1 is open. Cut off the external switch so that voltage is removed from the upstream circuit as well.

- **ORANGE cables are live even when switch 10Q1 is open.**



3. TECHNICAL DATA

3.1. Environmental Requirements for Installation and Storage

Required Conditions	
Operating ambient temperature	0 - 40°C
Ambient temperature in storage and transport environment	- 15°C to +60°C
Installation site	Pollution degree 2 or better. Do not install the equipment in direct sunlight and in areas which may be subject to conductive powders, corrosive gases, vibrations and water jets and leaking, in case the IP rating does not provide for suitable protection. Do not install in saline environments.
Altitude	Up to 1000 m asl
Operating ambient humidity	5% to 95%, 1g/m^3 to 25g/m^3, without condensation or ice formation (class 3k3 according to EN 50178).
Ambient humidity in storage environment	5% to 95%, 1g/m^3 to 25g/m^3, without condensation or ice formation (class 1k3 according to EN 50178).
Ambient humidity during transport	Maximum 95%, up to 60g/m^3, condensation may appear when the equipment is off (class 2k3 according to EN 50178).
Atmospheric pressure for operation and storage	86 to 106 kPa (class 3k3 and class 1k4 according to EN 50178).
Atmospheric pressure during transport	70 to 106 kPa (class 2k3 according to EN 50178).

3.2. Electrical Specifications of the Cabinet

Electrical Specifications	
Supply voltage	230Vac
Frequency	50Hz
Rated current (In)	1.5A

3.3. Mechanical Specifications of the Cabinet

Mechanical Specifications	
Dimensions WxHxD (mm)	- 600 x 800 x 400 (model SANTERNO PPC 15) - 600 x 1000 x 400 (model SANTERNO PPC 180)
Weight (kg)	- 45Kg (model SANTERNO PPC 15) - 55Kg (model SANTERNO PPC 180)
Degree of protection	IP44
Colour	RAL7035, orange peel. Phosphate conversion coating followed by epoxy polyester powder coating.

3.4. Electric and Communications Interface

Electric and Communications Interface	
Power Meter interface	3 Voltage transformers and 2 Current transformers
Communications interface	10/100 Ethernet RJ 45 Modbus TCP/IP

WARNING

Environmental conditions significantly affect the life-expectancy of the product; consequently, DO NOT install the product in a location which does not meet the required specifications.

4. HANDLING AND MOUNTING

4.1. Handling Conditions

Use a forklift truck to handle the equipment.

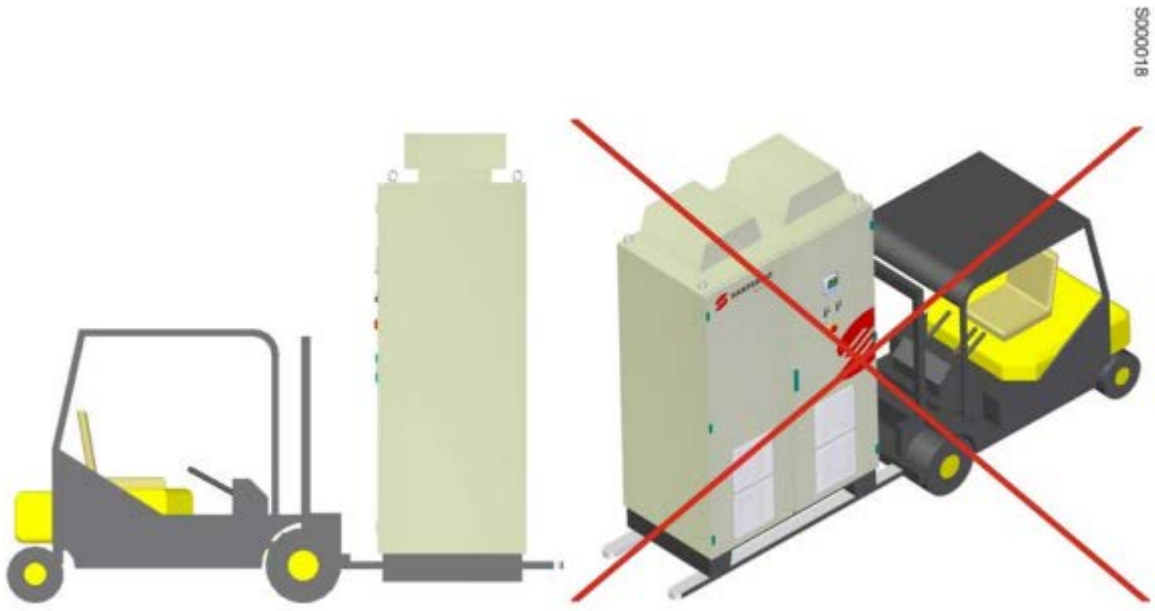
Refer to section Mechanical Specifications of the Cabinet.

WARNING

For safety reasons and to ensure correct operation, it is strictly PROHIBITED to tilt the cabinet forwards or backwards.

4.2. Handling Using a Pallet Jack or Forklift Truck

If the cabinet is to be lifted from underneath, a forklift truck must be used. Position the fork tines in the spaces along the base which must be opened up beforehand by removing the central base panels.



5. INSTALLATION

The Power Plant Controller is part of a system, so no particular installation instructions are given. However, it is necessary to take all possible measures to avoid exposing the equipment to direct sunlight, in order to keep the internal temperature ranging within the allowable limit values (this applies to force-ventilated cabinets).

5.1. Identifying the Functional Voltage of the Circuits Internal to the Equipment

Wiring has been made in order to identify the operating voltages of the circuit sections based on the colours of the isolating sheath of the cables:

BLACK AND LIGHT BLUE	AC, DC power wiring >120V, or for cables other than those mentioned in this table
BLUE	24 Vdc auxiliary circuit wiring
ORANGE	Wiring of the circuits supplied by external power supply sources and not cut off from the master switch
YELLOW-GREEN	Wiring of the safety equipotential circuit

5.2. Description of the Cabinet

The cabinet may be accessed from its front side only. Its main function is to adjust the active power and reactive power at the point of interconnection (POI) by interacting with the inverters on the field. Disconnector 10Q1 is located on the front panel. It delivers power supply to the whole cabinet, or cuts off power supplied when required. ORANGE cables may be live even when switch 10Q1 is open. A switch inside the cabinet controls power distribution to all LV devices (PLC comms board and HMI).

The pictures below show the front view of the SANTERNO PPC 15 cabinet:

The pictures below show the front view of the SANTERNO PPC 180 cabinet:

The cabinet components are grouped to form functional areas. The lower part houses the power supply terminals. The middle part houses the fuses (SANTERNO PPC 15 cabinet only), relays, switches and the Modbus TCP/IP communication switch. The upper part houses the PLC with the relevant communications board. The 12” touch panel is located on the front door of the SANTERNO PPC 15 cabinet. The 9” touch panel is located on the front door of the SANTERNO PPC 180 cabinet.

IMPORTANT:

In any case, *absolute safety does not exist*, as stated in the CEI 11 - 15 standard, paragraph 1.1.02 quoted below:

Omissis.....

No regulation, notwithstanding its degree of accuracy, is able to guarantee absolute immunity to people and goods against the dangers of electricity.
The implementation of the prescriptions contained in these standards can reduce hazard exposure but cannot avoid a condition in which accidental events may determine a dangerous situation for people and goods.

As a matter of facts, 'safe' stands as a synonym for 'compliant with state-of-the-art practices'. Such practices represent a set of rules that allow implementing a safety level which is considered to be acceptable by the community, on the basis of current technical and technological knowledge and economical resources.

The state of the art continually evolves and the standards describe its evolution over time.

In particular, according to the Italian law No. 186 of March 1, 1968 a product compliant with CEI (Comitato Elettrotecnico Italiano) standards means a product constructed in compliance with state-of-the-art practices.

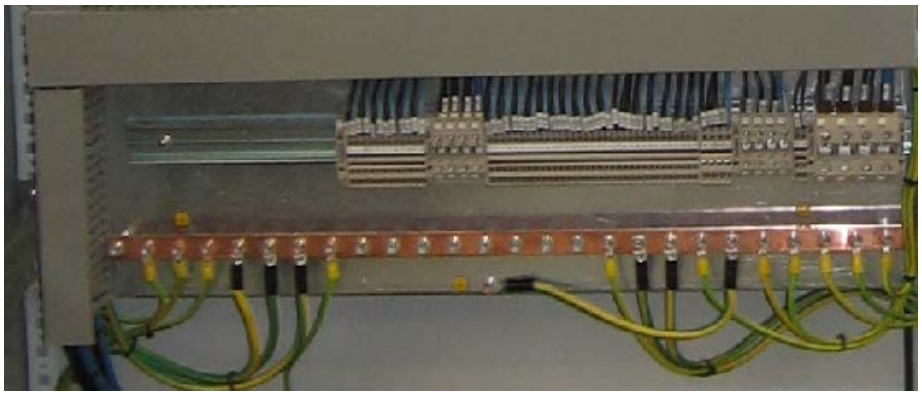
The equipment described in this manual is compliant with CEI standards and, therefore, it is to be considered ***safe in the sense of what is described above***.

5.3. Grounding

DANGER

ALWAYS GROUND THE EQUIPMENT!

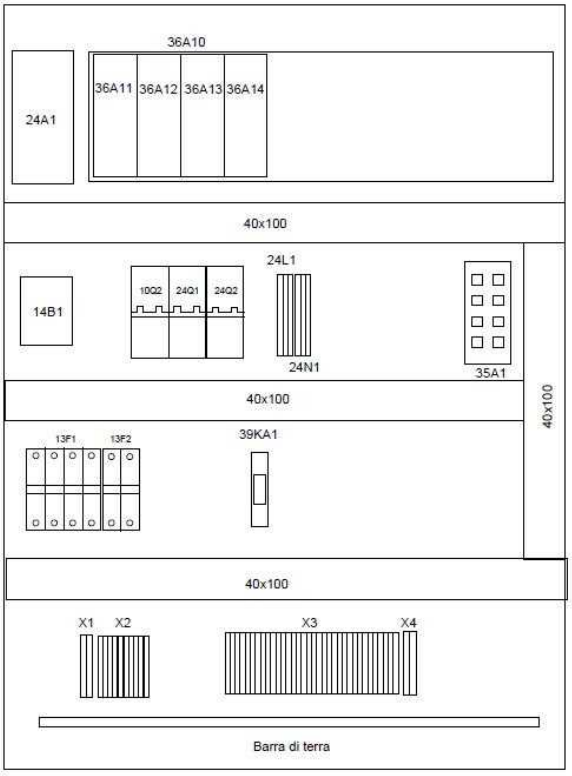
Connect the cabinet to the equipotential bonding.
A ground collector bar is provided inside the cabinet, collecting all the equipotential bonding connection.
The ground collector bar is in the lowest part of the cabinet.



5.4. Positions of the Terminal Boards for the Connection of the Incoming Cables

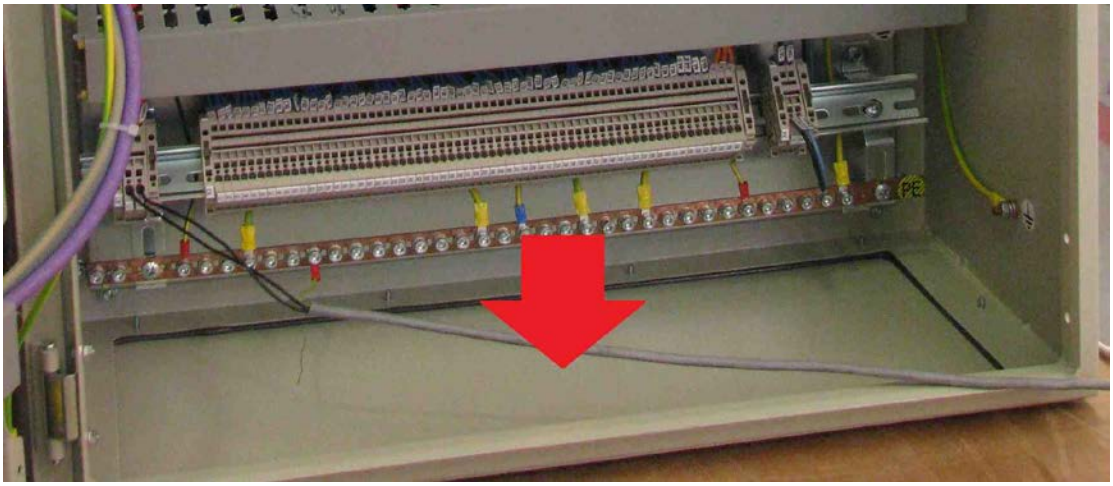
The figure below shows the positions of the terminal boards for the connection of the incoming cables.

Terminal boards are marked with an X followed by a digit (for example X4); this identifier is located on the cabinet on the top part of the terminal board.



5.5. Cable Entry

The cabinet bottom panel may be removed by loosening the screws on its sides. Before wiring the cables, drill the panel where cable entry is required.
The cabinet bottom is shown in the figure below.



5.6. Cable Cross-sections

SANTERNO PPC 15 Cabinet

X1: N. 2 terminals for 0.5...4mm^2 flex cable

X2: N. 10 terminals for 0.5...2.5mm^2 flex cable

X3: N. 34 terminals for 0.5...2.5mm^2 flex cable

X4: N. 2 terminals for 0.5...4mm^2 flex cable

SANTERNO PPC 180 Cabinet

X1: N. 2 terminals for 0.5...4mm2 flex cable

X3: N. 65 terminals for 0.5...2.5mm^2 flex cable

X4: N. 2 terminals for 0.5...4mm^2 flex cable

5.7. Terminal Functions for SANTERNO PPC 15

The terminal lists given in this section describe the full functionality of the Power Plant Controller. Check the optionals fitted in the substation and the relevant connections.

Terminal board X1 is for the connection of the supply voltage to the cabinet.

X1	**Line Input Terminals**	
Terminal	Description	Potential
1	230Vac 50Hz Line input	L
2	Neutral	N

Terminal X2 is for the power supply of the CTs, the VTs and the Power Meter

X2	**CTs, VTs and Power Meter**	
Terminal	Description	Potential
1	Voltage transformer L1	
2	Voltage transformer L2	
3	Voltage transformer L3	
4	Neutral of the star centre of the Voltage transformer L1, L2 and L3	
5	Current transformer secondary S1 phase L1	
6	Current transformer secondary S2 phase L1	
7	Current transformer secondary S1 phase L2	
8	Current transformer secondary S2 phase L2	
9	Current transformer secondary S1 phase L3	
10	Current transformer secondary S2 phase L3	

Terminal X3 is for the PLC inputs and outputs and the voltage-free contacts of the auxiliary relay

X3	Terminal Board	
Terminal	Description	Potential
1	Digital Input E0.0 PLC - free	
2	Digital input E0.1 PLC - free	
3	Digital input E0.2 PLC - free	
4	Digital input E0.3 PLC - free	
5	Digital input E0.4 PLC - free	
6	Digital input E0.5 PLC - free	
7	Digital input E0.6 PLC - free	
8	Digital input E0.7 PLC - free	
9	Digital input E1.0 PLC - free	
10	Digital input E1.1 PLC - free	
11	Digital input E1.2 PLC - free	
12	Digital input E1.3 PLC - free	
13	Digital input E1.4 PLC - free	
14	Digital input E1.5 PLC - free	
15	Digital input E1.6 PLC - free	
16	Digital input E1.7 PLC - free	
17	Digital output A0.1 PLC - free	
18	Digital output A0.2 PLC - free	
19	Digital output A0.3 PLC - free	
20	Digital output A0.4 PLC - free	
21	Digital output A0.5 PLC - free	
22	Digital output A0.6 PLC - free	
24	Digital output A1.0 PLC - free	
25	Digital output A1.1 PLC - free	
26	Digital output A1.2 PLC - free	
27	Digital output A1.3 PLC - free	
28	Digital output A1.4 PLC - free	
29	Digital output A1.5 PLC - free	
30	Digital output A1.6 PLC - free	
31	Digital output A1.7 PLC - free	
32	N.C., voltage-free contact 39KA1	
33	Common, voltage-free contact 39KA1	
34	N.O., voltage-free contact, 39KA1	

Terminal X4 is the for the cabinet cooling fan

X4	Cooling Fan Terminals	
Terminal	Description	Potential
1	230Vac 50Hz output	L
2	Neutral	N

5.8. Terminal Functions for SANTERNO PPC 180

The terminal lists given in this section describe the full functionality of the Power Plant Controller. Check the optionals fitted in the substation and the relevant connections.

Terminal board X1 is for the connection of the supply voltage to the cabinet.

X1	**Line input terminals**	
Terminal	Description	Potential
1	230Vac 50Hz Line input	L
2	Neutral	N

Terminal X3 is for the PLC inputs and outputs and the voltage-free contacts of the auxiliary relay

X3	**Terminal Board**	
Terminal	Description	Potential
1	Digital input E0.0 PLC - free	
2	Digital input E0.1 PLC - free	
3	Digital input E0.2 PLC - free	
4	Digital input E0.3 PLC - free	
5	Digital input E0.4 PLC - free	
6	Digital input E0.5 PLC - free	
7	Digital input E0.6 PLC - free	
8	Digital input E0.7 PLC - free	
9	Digital input E1.0 PLC - free	
10	Digital input E1.1 PLC - free	
11	Digital input E1.2 PLC - free	
12	Digital input E1.3 PLC - free	
13	Digital input E1.4 PLC - free	
14	Digital input E1.5 PLC - free	
15	Digital input E1.6 PLC - free	
16	Digital input E1.7 PLC - free	
17	Digital input E2.0 PLC - free	
18	Digital input E2.1 PLC - free	
19	Digital input E2.2 PLC - free	
20	Digital input E2.3 PLC - free	
21	Digital input E2.4 PLC - free	
22	Digital input E2.5 PLC - free	
23	Digital input E2.6 PLC - free	
24	Digital input E2.7 PLC - free	
25	Digital input E3.0 PLC - free	
26	Digital input E3.1 PLC - free	
27	Digital input E3.2 PLC - free	
28	Digital input E3.3 PLC - free	
29	Digital input E3.4 PLC - free	
30	Digital input E3.5 PLC - free	
31	Digital input E3.6 PLC - free	
32	Digital input E3.7 PLC - free	
33	Digital output A0.1 PLC - free	
34	Digital output A0.2 PLC - free	
35	Digital output A0.3 PLC - free	
36	Digital output A0.4 PLC - free	
37	Digital output A0.5 PLC - free	

38	Digital output A0.6 PLC - free	
39	Digital output A1.0 PLC - free	
40	Digital output A1.1 PLC - free	
41	Digital output A1.2 PLC - free	
42	Digital output A1.3 PLC - free	
43	Digital output A1.4 PLC - free	
44	Digital output A1.5 PLC - free	
45	Digital output A1.6 PLC - free	
46	Digital output A1.7 PLC - free	
47	Digital output A2.0 PLC - free	
48	Digital output A2.1 PLC - free	
49	Digital output A2.2 PLC - free	
50	Digital output A2.3 PLC - free	
51	Digital output A2.4 PLC - free	
52	Digital output A2.5 PLC - free	
53	Digital output A2.6 PLC - free	
54	Digital output A2.7 PLC - free	
55	Digital output A3.0 PLC - free	
56	Digital output A3.1 PLC - free	
57	Digital output A3.2 PLC - free	
58	Digital output A3.3 PLC - free	
59	Digital output A3.4 PLC - free	
60	Digital output A3.5 PLC - free	
61	Digital output A3.6 PLC - free	
62	Digital output A3.7 PLC - free	
63	N.C., voltage-free contact 41KA1	
64	Common, voltage-free contact 41KA1	
65	N.O., voltage-free contact 41KA1	

Terminal X4 is the for the cabinet cooling fan

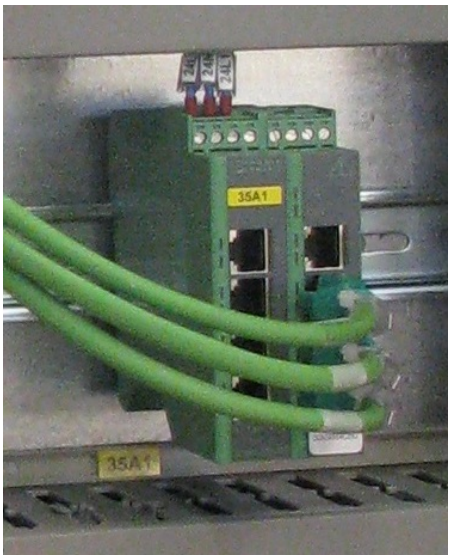
X4	**Cooling Fan Terminals**	
Terminal	Description	Potential
1	230Vac 50Hz output	L
2	Neutral	N

5.9. Switches Installed on the Power Plant Controller

The PPC switches and their functionality are given in the table below.

Identifier	Poles	Characteristic	Rated Current (A)	Description of the Function
10Q1	3P		25A	230Vac 50Hz Line input master switch
10Q2	2P	C	6A	Cabinet master switch
24Q1	2P	C	6A	TRIO-PS/1AC/24DC power supply switch
24Q2	2P	C	6A	24Vdc line switch

5.10. Ethernet TCP/IP Communications Interface Wiring



The Power Plant Controller wiring to the Ethernet network is to be made using only one network cable.

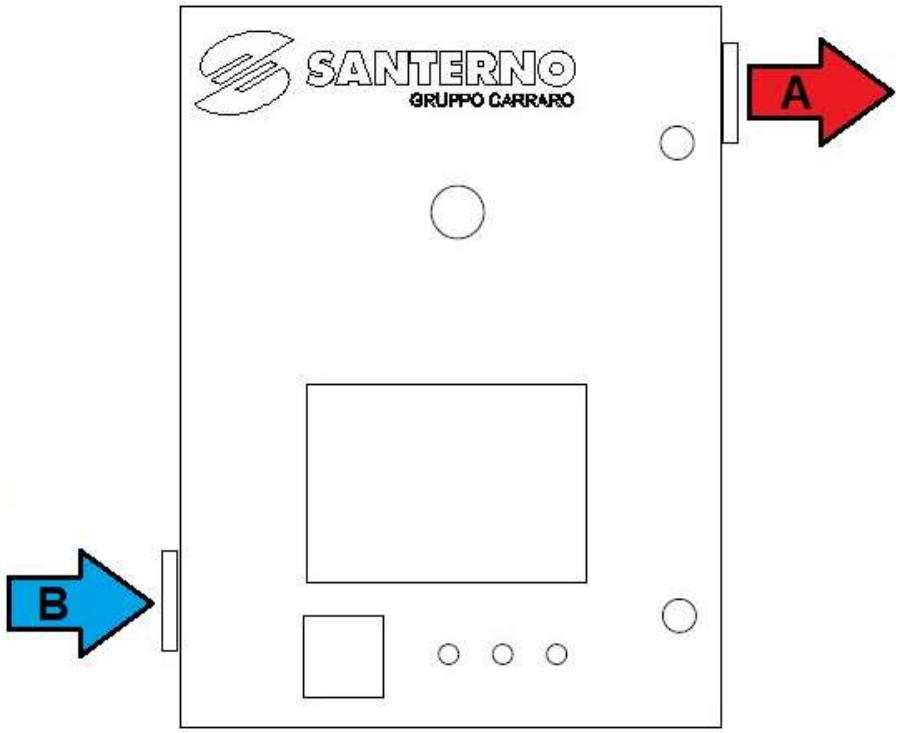
The incoming Ethernet cable may be connected to the internal switch (35A1 in the wiring diagram).

Failure to do so can lead to serious communications failures severely affecting the functionality of the Power Plant Controller.

5.11. Cabinet Ventilation

The cabinet is equipped with a cooling fan located on the right side of the enclosure, as well as with an air suction filter located on the left side of the enclosure.
Keep areas close to the air filter and the cooling fan free from obstacles to allow for free circulation of air.
The fan flow rate is 41m^3/h.

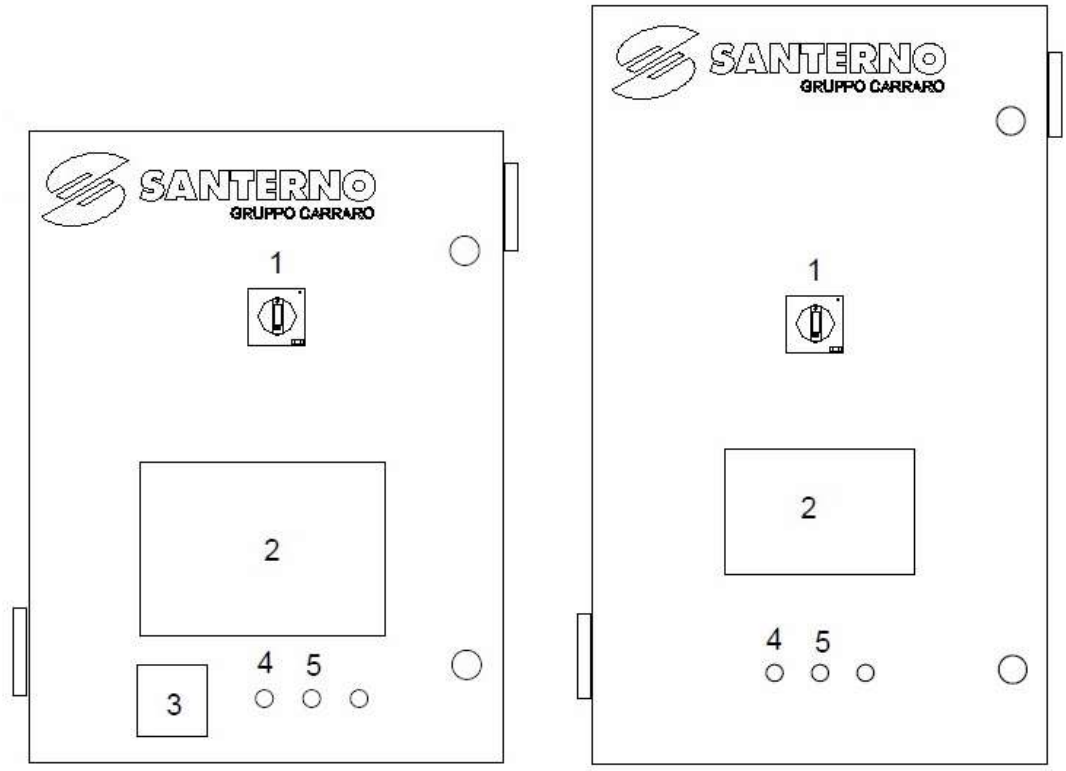
The figure below shows the air cooling system of the cabinet.



A = Hot exhaust air
B = Fresh air intake

5.12. Commands on the Cabinet Front

The following commands are located on the cabinet door.



1 Master switch or disconnect switch 10Q1 for the Power Plant Controller. It is always provided with padlocks in open position preventing the switch from closing. The locking slot may house maximum 3 padlocks - Ø 7 mm (not supplied).

2 Touch panel. 12” touch panel on model SANTERNO PPC 15; 9” touch panel on model SANTERNO PPC 180. The touch panel enables setting up and manually controlling the PPC. The HMI is described in section INSTALLATION.

3 Power Meter (if fitted). This device allows adjusting the power values based on the desired power output.

4 White indicator light. If on, this means that the cabinet is powered.

5 Red indicator light. If on, this means that an alarm tripped.

6. MAINTENANCE

Adequate maintenance ensures that performance and reliability is maintained over time.

This heading describes all the activities required to keep the cabinet parts which are subject to wear and deterioration and/or components which are essential for guaranteeing safety and optimum performance in good condition.

Access to products for the purpose of maintenance, modifications and management involves all persons responsible for production and maintenance. It must be carried out in observance of the health and safety regulations described in section Execution of Work.

The minimum maintenance interval is indicated in the Maintenance Sheet.

Equipment installed in an environment where there is a high concentration of dust requires more frequent maintenance than generally indicated.

WARNING

Failure to observe maintenance prescriptions may result in the product warranty conditions being nullified.

NOTE

In the event of any fault, please contact the CUSTOMER SERVICE of Elettronica Santerno SpA for instructions on the necessary corrective actions to be taken.

6.1. Maintenance Sheet

Maintenance tasks	Minimum frequency
Check the external/internal conditions of the electrical cabinet	6 months
Air filter maintenance	6 months
Check gaskets	12 months
Check locks and hinges	12 months
Check fans	6 months
Check control and auxiliary voltages (230 V and 24 V)	6 months
Check relays and modular switches	12 months
Check cable tightening	12 months
Check product labels, nameplates and warning signs	24 months
The frequency of scheduled maintenance may need to be increased depending on the location in which the equipment is installed and the relative ambient conditions.	

6.2. Check the External/Internal Conditions of the Cabinet

DANGER

Death from electrocution and burns due to contact with live components.

Make sure that no voltage is applied to the equipment. Power must be cut off.

Before accessing the cabinet, follow the instructions given in section Accessing the Equipment: Safety Procedure.

Dot not touch any components other than those mentioned in this instruction manual.

To check the external/internal conditions of the electrical cabinet, proceed as follows:

OVERALL CONDITION OF THE CABINET:

- Check the external condition of the cabinet.
- Check the state of the insulating sheaths on the conductors.
- Check that there are no signs of overheating on the power conductors (especially near the connection points on the equipment).
- Check that there are no signs of cable gnawing caused by rodents.
- Check the state of all the signs/nameplates affixed to the equipment. Signs must always be in good condition and legible.

GENERAL CABINET CLEANING:

- Check the interior of the cabinet for the build-up of dust, dirt, humidity and infiltration of water from the outside.
- Check that the ventilation ducts on the inductors and transformers are clear.

Should it be necessary to clean the cabinet, always adopt adequate measures.

6.3. Air Filter Maintenance

DANGER

Death from electrocution and burns due to contact with live components.

Make sure that no voltage is applied to the equipment. Power must be cut off.

Before accessing the cabinet, follow the instructions given in section Accessing the Equipment: Safety Procedure.

The cabinet is equipped with air intake grilles fitted with felt filters (efficiency class EN 779: G2). Maintenance activities consist of replacing the felt filters.

The front air intake grille can be removed by inserting a screwdriver in the point indicated and gently levering it out. The felt is held in a cavity in the air intake grille which is securely fastened to the cabinet door.

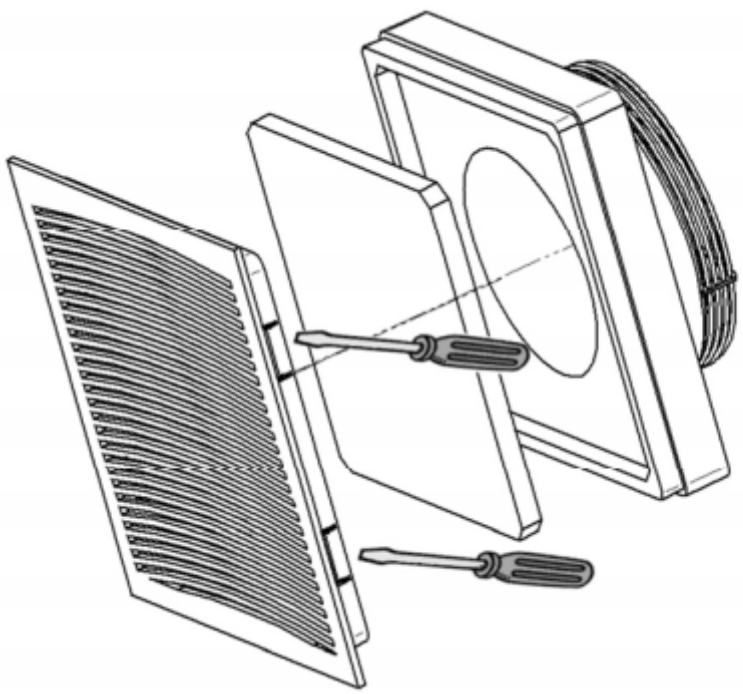
The type of felt filters used must be suitable for the application.

The spare felts may be purchased from Elettronica Santerno.

NOTE

In the event of any fault, please contact the CUSTOMER SERVICE of Elettronica Santerno SpA for instructions on the necessary corrective actions to be taken.

The figure shows how to replace the filter felt.



6.4. Checking the Seals, Locks and Hinges

DANGER

Death from electrocution and burns due to contact with live components.

Make sure that no voltage is applied to the equipment. Power must be cut off.

Before accessing the cabinet, follow the instructions given in section Accessing the Equipment: Safety Procedure.

To check the cabinet door seals, locks and hinges, proceed as follows:

- Visually inspect the cabinet seals for any signs of cracking or damage. Any seals showing signs of damage in the areas of door contact must be completely replaced.
- It is suggested that talc be used to stop the seals from sticking to the sheet metal of the cabinet over time.
- Check correct operation of the cabinet locks by locking and unlocking the doors.
- Check if the door hinges operate smoothly.
- Spray all movable parts and parts subject to wear with a water-free lubricant.

6.5. Check the Fan

DANGER

Death from electrocution and burns due to contact with live components.

Dot not touch any components other than those mentioned in this instruction manual.

Check operation and noisiness of the fan installed on the left side of the cabinet.

If required, open the cabinet door to force fan operation.

The fan can be started up by thermostat 14B1 installed inside the cabinet and by setting a lower temperature than the ambient temperature.

At the end of inspection:

- Restore the thermostat to the initial temperature value.
- Close the electrical cabinet doors.

6.6. Checking Control and Auxiliary Voltages (24 Vdc 230 Vac)

DANGER

Death from electrocution and burns due to contact with live components of the grid.

Dot not touch any components other than those mentioned in this instruction manual.

To check the cabinet control and auxiliary voltages, follow the instructions provided below.
The exact position of the control points can be seen on the Electrical and Mechanical Schematic.

To check the 24 Vdc power supply proceed as follows:

- Open the cabinet door
- Check the presence of 24 Vdc control voltage on the terminals on switch 24Q2
- Close the cabinet door

To check the 230 Vac power supply proceed as follows:

- Open the cabinet door
- Check the presence of 230 Vac control voltage on the terminals on switch 10Q2.
- Close the cabinet door

6.7. Checking the Relays and Switches

DANGER

Death from electrocution and burns due to contact with live components of the grid.

Make sure that no voltage is applied to the equipment. Power must be cut off.

Before accessing the cabinet, follow the instructions given in section Accessing the Equipment: Safety Procedure.

This section refers to all relays and switches located inside the cabinet.

- Visually inspect the installed fuses, making sure that they are correctly inserted into their holders. Check the presence of the fixing springs on the fuse holder socket.
- Visually inspect the modular switches installed. Check their mechanical and electrical functionality.

6.8. Checking the Tightening Torque

DANGER

Death from electrocution and burns due to contact with live components.

Make sure that no voltage is applied to the equipment. Power must be cut off.

Before accessing the cabinet, follow the instructions given in section Accessing the Equipment: Safety Procedure.

- Check the tightness of all the terminal clamps for connecting the power wiring and tighten, if necessary.
- Pay particular attention to any colour variations or anomalies concerning the insulation and the terminals.

The minimum tightening torques to be used can be gathered from the Manufacturer's technical notes.

7. DESCRIPTION OF THE HMI

7.1. Navigation Bar

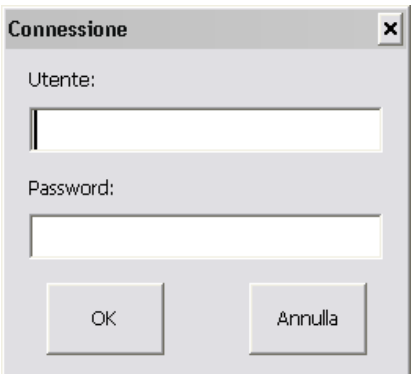
A navigation bar is available at the bottom of each page of the HMI.

Navigation bar example:

Button	Description
	Goes to the **Trend** page
	Goes to the **Limits** page, where the limit thresholds may be set for certain parameters. The red lock indicates that the level 3 password (administrator level) is required
	Goes to the **Set point** page. The yellow lock indicates that the level 2 password (supervisor level) is required
	This button enables or disables the regulators' operation. The red lock indicates that the level 3 password (administrator level) is required
	This button is to be found on all the pages of the HMI. Press this button from any page to go back to the **Main Page**
	Goes to the next page or the upper-level page
	Goes to the previous page or the lower-level page

7.2. Password

If a password is required, the window below will automatically appear along with a virtual keyboard. Enter the username and password and press **OK**. Press **CANCEL** to close the window without logging in.

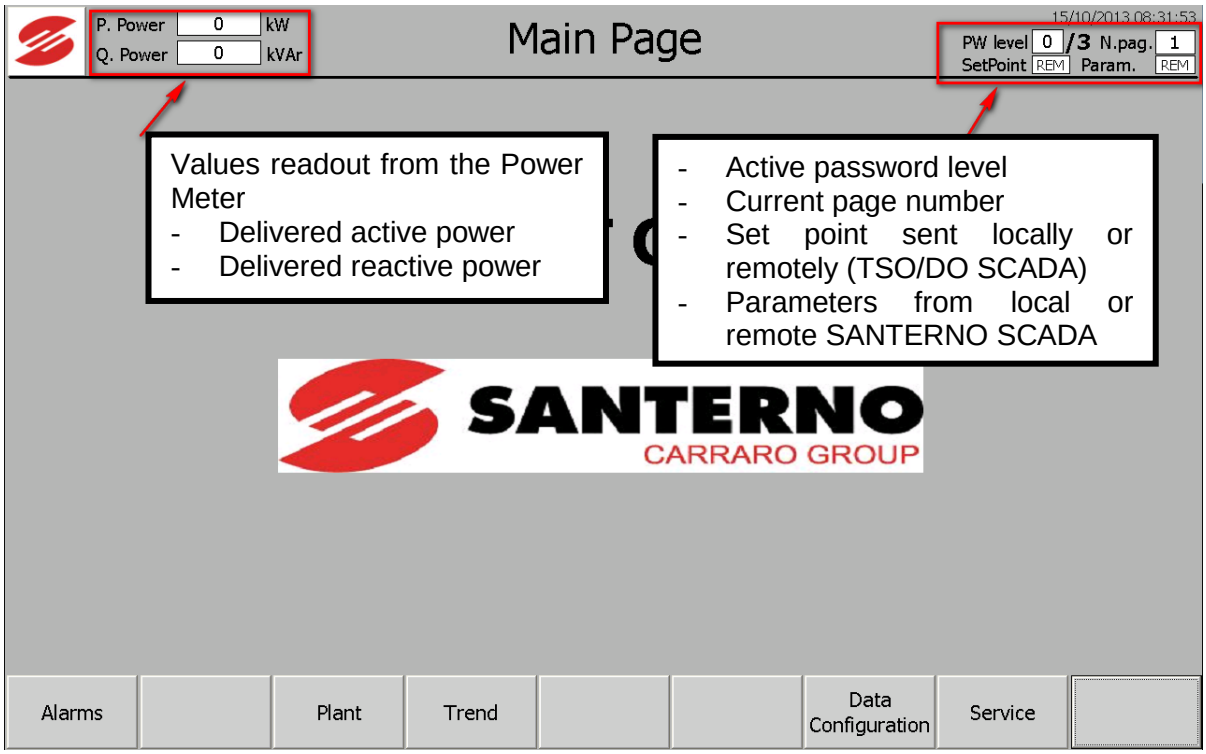


Three password levels are provided for the HMI to access the configuration parameters of the Power Plant Controller. The data or pages that are password-protected are marked by different pictograms (red, yellow, green lock), as shown below.

Username	Password	Pictogram	Description
9			Level 3 password, administrator. The administrator may execute all-level operations (level 1, level 2, level 3). **The "administrator" pages are for Santerno's service personnel.**
2			Level 2 password, supervisor. The supervisor may execute also level 1 operations.
1	111		Level 1 password, operator.

7.3. Description of the HMI Pages

The **Main Page** appears when the touch panel is turned on.
The following information is given on all pages:



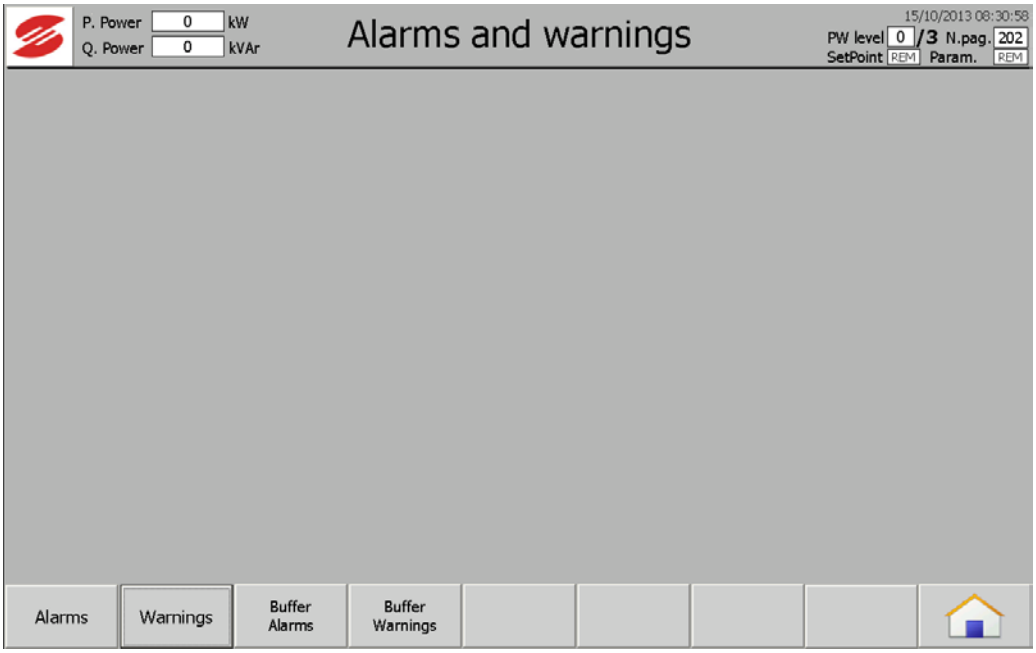
The buttons at the bottom of each page allow navigating among the pages of the HMI.

From the **Main Page**, the following pages may be accessed:

Button	Description
Alarms	Goes to the pages related to the alarms, diagnostic messages and history data
Plant	Goes to the page displaying the Plant Data (variables of the PV plant)
Trend	Goes to the graphs displaying the power output and the plant set points
Data Configuration	Goes to the Power Plant Controller configuration pages
Service	Goes to the Service page, where you can set the system clock, log out ant shut down the HMI

7.3.1. Alarms and Warnings

This page displays alarms, messages and history data.



At the bottom of each page there are 4 buttons allowing accessing the following pages:

Button	Description
Alarms	Press this button to display a pop-up page showing the alarms tripped
Warnings	Press this button to display a pop-up page showing the events fired
Buffer Alarms	Press this button to access the page showing the alarm history
Buffer Warnings	Press this button to access the page showing the warning history

The table below details the alarm messages that may appear.

Alarm	Alarm message	Possible Cause	Possible solution
ALL001	Regulators Disabled	- The PPC has just been started - The regulators have just been disabled by the user - Communications failure in too many inverters	- When the PPC is powered on, it disables the regulators for the first 60 seconds so that all devices may start up. The regulators are enabled when this initialization stage is over. - Enable the regulators from the **Regulation Data** page (local mode) or from the remote interface - This alarm trips if the number of inverters in emergency condition is over the **Max Inverter Offline** parameter. Check the value set for this parameter.

ALL002	Antiwind up P Regulator active	- The regulator cannot reach the preset active power set point - The active power regulator is in saturation mode	- Check if the set point ranges within the allowable range set by the parameters on the **Regulation Data** page. - - Check the operating conditions of the inverters
ALL003	Antiwind up Q Regulator active	- The regulator cannot reach the preset reactive power set point - The reactive power regulator is in saturation mode	- Check if the set point ranges within the allowable range set by the parameters on the **Regulation Data** page. - Check the operating conditions of the inverters
ALL004	Regulator P. Saturation ON	- The regulator output is higher or lower than the threshold set in the **Regulation Data** page - The available power in the PV plant does not allow achieving the power set point	- Check if the set point ranges within the allowable range set by the parameters on the **Regulation Data** page**.** - Check the operating conditions of the inverters
ALL005	Regulator Q. Saturation ON	- The regulator output is higher or lower than the threshold set in the **Regulation Data** page - Some inverters are off due to bad weather conditions	- Check if the set point ranges within the allowable range set by the parameters on the **Regulation Data** page. - Check the operating conditions of the inverters
ALL006	Antiwind up U Regulator active	- The regulator cannot achieve the voltage set point - The voltage regulator is in saturation mode	- From the **Trend** page, check if the reactive power set point ranges within the allowable range set by the parameters on the **Regulation Data** page. - Check the operating conditions of the inverters

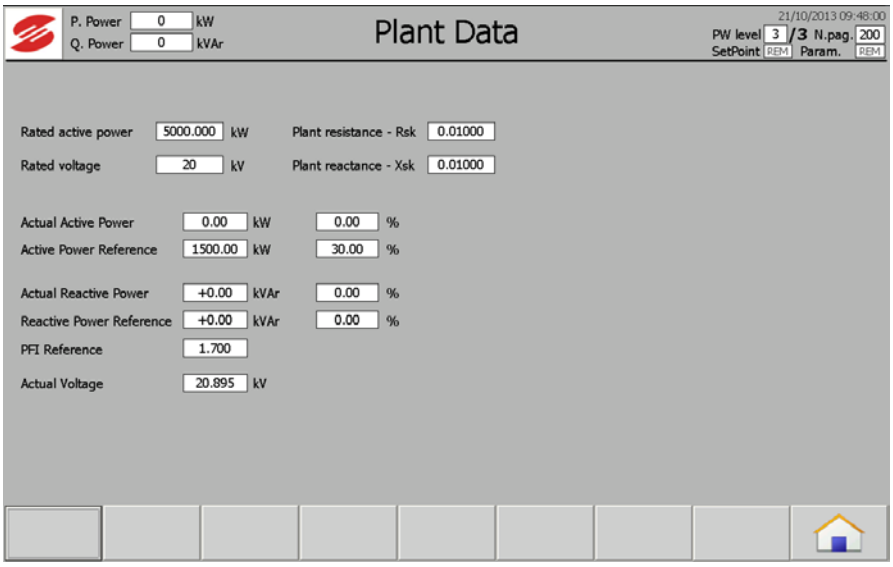
ALL007	Regulator U. Saturation ON	- The regulator output is higher or lower than the threshold set in the **Regulation Data** page - Some inverters are off due to bad weather conditions	- From the **Trend** page, check if the reactive power set point ranges within the allowable range set by the parameters on the **Regulation Data** page. - Check the operating conditions of the inverters
ALL009	Kpc out of range	The calculated Kpc is out of the allowable range set in the Limits page	- Check the value of the regulator parameters influencing the Kpc - Check the limits set for the Kpc
ALL010	Kfc out of range	The calculated Kfc is out of the allowable range set in the Limits page	- Check the value of the regulator parameters influencing the Kfc - Check the limits set for the Kfc
ALL033	Power meter communication error	No communication between the PLC and the Power Meter	- Check if the Power Meter is properly power supplied - Check the correct wiring of the network cable between the PLC and the Power Meter - Check if the communications parameter settings (Ip, Mask…) in the Power Meter are correct
ALL034	Power meter disabled by HMI	The Power Meter has been disabled by the user	Enable the Power Meter from the relative page.
ALL129 fino al ALL143	Inverter ### IP Address Error	When powered on, the PPC creates the communications channels to the inverters. This alarm indicates that the PPC cannot communicate with the inverter indicated	- Check if the addresses of the inverter in an emergency are properly set up - Check if the PPC is properly connected to the inverters in an emergency
ALL241 fino al ALL426	Alarm communication inverter ###	No communication between the PLC and the inverter indicated	- Check the inverter operating conditions - Check the correct wiring of the network cable between the PLC and the Power Meter - Check if the communications parameter settings (Ip, Mask…) in the Power Meter are correct

The table below shows the messages that may appear.

Message	Message text	Description	Notes
MSG001	Password E.Santerno active	Indicates that someone has logged in typing the SANTERNO password	The password becomes invalid after 5 minutes inactivity
MSG002	Password TSO/DO active	Indicates that someone has logged in typing the TSO/DO password	The password becomes invalid after 5 minutes inactivity

7.3.2. Plant Data

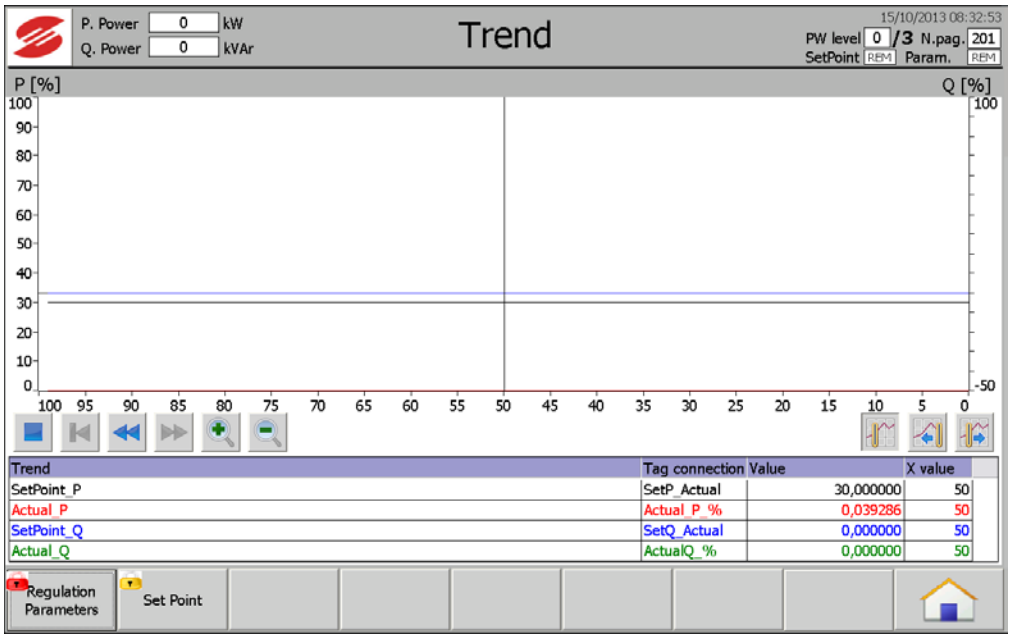
This page displays the power set points and some plant variables measures by the Power Meter:


P. Power 0 kW
Q. Power 0 kVAr
Plant Data
21/10/2013 09:48:00
PW level 3 /3 N.pag. 200
SetPoint REM Param. REM
Rated active power 5000.000 kW
Rated voltage 20 kV
Plant resistance - Rsk 0.01000
Plant reactance - Xsk 0.01000
Actual Active Power 0.00 kW 0.00 %
Active Power Reference 1500.00 kW 30.00 %
Actual Reactive Power +0.00 kVAr 0.00 %
Reactive Power Reference +0.00 kVAr 0.00 %
PFI Reference 1.700
Actual Voltage 20.895 kV

Variable	Description	Notes
Rated active power	Rated active power of the PV plant	Full-scale value of the active and reactive power percent
Rated voltage	Rated voltage of the PV plant at the connection point of the Power Meter	
Plant resistance - Rsk	Line equivalent resistance	Used by the voltage regulator only (regulator not always available)
Plant reactance - Xsk	Line equivalent reactance	Used by the voltage regulator only (regulator not always available)
Actual active power	Active power measured by the Power Meter	
Active power reference	Active power set point	100% equals the **Rated active power**
Actual reactive power	Reactive power measured by the Power Meter	
Reactive power reference	Reactive power set point	
PFI reference	Power factor index set point	The reactive power regulator may operate with reactive power reference or PFI (section 7.3.5)
Actual voltage	Voltage measured by the Power Meter at the connection point	

7.3.3. Trend

This page displays the trends of the set points and the active and reactive power measures.



Track	Description
Black track	Trend of the active power set point
Red track	Trend of the active power delivered by the plant and measured by the Power Meter
Blue track	Trend of the reactive power set point
Green track	Trend of the reactive power delivered by the plant and measured by the Power Meter

The values percent for the delivered active power, reactive power and their set points are displayed at the bottom of the page. Those values relate to the point in the graph indicated by the upright marker. Use the two buttons in the bottom right corner to change the marker position.

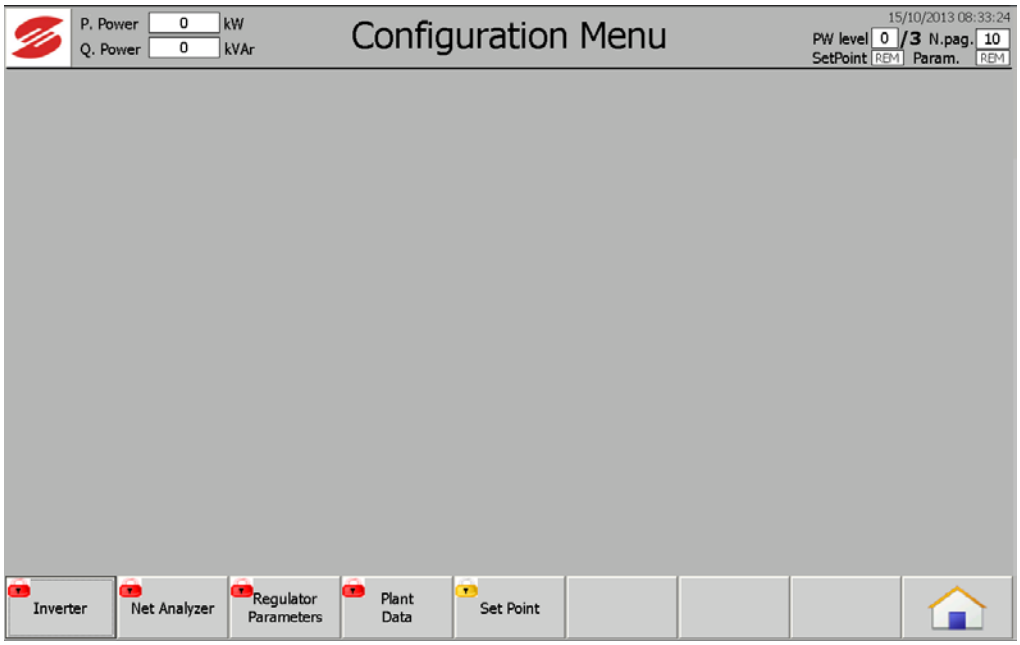
The Trend graph is very helpful when tuning the regulators, as it helps check the regulation efficiency and the presence of overshoots (if any) when the reference of the reactive power/active power varies.

7.3.4. Configuration Menu

This page allows accessing the Power Plant Controller configuration pages. The administrator password (level 3) is required to open the **Inverter**, **Power Meter**, **Regulator Parameter** and **Plant Data** pages.

All pages protected by a level 3 password can be accessed by the Santerno Service personnel only.

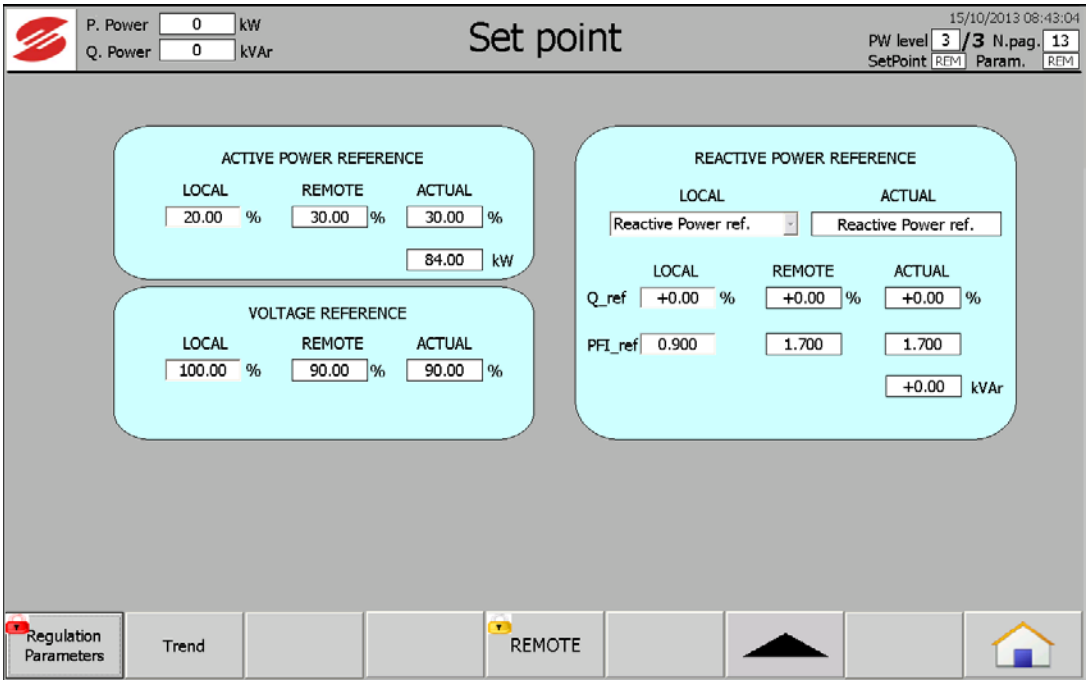
The **Set Point** page may be accessed by entering the supervisor password (level 2).



Button	Description
Inverter	Press this button to configure and enable the inverters in the plant
Net Analyzer	Goes to the Power Meter configuration page
Regulator Parameters	Goes to the page including all the regulators parameters of the PPC
Plant Data	Goes to the page allowing configuring the plant data
Set Point	Goes to the page allowing controlling the active power set point, the reactive power set point and the voltage set point

7.3.5. Set Point

This page allows setting the active power set point, the reactive power set point and the voltage set point (the voltage reference is not always displayed).



The LOCAL, REMOTE and CURRENT values of the set points are given for each regulator. The set points may be set up directly from the touch panel only if the “Local” set point mode is activated. To do so, press the “Local/Remote” button at the bottom of the page (supervisor password, level 2, required).

Section	Description	Notes
Active power reference	Allows setting the active power set point	100% equals the rated power of the PV plant displayed on top of the **Plant Data** page
Reactive power reference	- The first drop-down menu allows choosing the reactive reference Q or the PFI reference. The side box shows the type of reference that is currently activated - The **Q_ref** box sets the reactive power Q set point - The **PFI_ref** box sets the PFI set point	Enter the Local mode to change the reference type
Voltage reference	Sets the voltage set point	**The voltage regulator is not always available**

7.3.6. Service

The **Service** page allows doing the following: suspend the panel runtime; set date and time; log out.

The correct date and time setting is required for the trip logs and history data.

Button	Description
	This button shuts down the touch panel. **The level 3, administrator password, (Santerno service personnel only) is required.**
	Once the date and time are set in the **Modify** box, press “Set time” to update them. The green lock indicates that the level 1 password (operator) is required
	Press this button to log out.

8. DATA TRANSFER VIA MODBUS TCP/IP PROTOCOL

The PPC displays the following data, accessible via ModBus TCP/IP protocol by establishing a connection to an address from the address list including all the addresses of the devices in the PV plant. Use port 502 defined by the ModBus to establish a connection.

Description	Data item	Register address	Scale factor	Unit of measure	R/W
Line frequency	INT32	1	1000	Hz	R
Measured active power	INT32	3	1000	KW	R
Measured reactive power	INT32	5	1000	KVAr	R
Line voltage	INT32	15	1000	V	R
Regulators status	INT16	17	1		R
Reactive power set point selection: 0→ Reactive power set point 1→ Power factor index set point	INT16	18	1		R/W
Set point source (Local/Remote)	INT16	19	1		R
Active power set point	INT32	31	100	%	R/W
Reactive power set point	INT32	33	100	%	R/W
Power factor index set point	INT32	35	1000		R/W
Voltage set point	INT32	37	100	%	R/W

Register bitmapping: **Regulators status (register address: 17)**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	0 = Regulators disabled 1 = Regulators enabled	0 = Voltage regulator, linear pattern 1 = Voltage regulator, saturation	0 = Reactive power regulator, linear pattern 1 = Reactive power regulator, saturation	0 = Active power regulator, linear pattern 1 = Active power regulator, saturation

Register bitmapping: **Local/Remote set points (register address: 19)**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	0=Local set point control 1=Remote set point control	0=Local parameter regulators control 1=Remote parameter regulators control